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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :		(11) International Publication Number:
D21F 1/00	A1	WO 97/08382
		(43) International Publication Date: 6 March 1997 (06.03.97)

(21) International Application Number: PCT/FI96/00451

(22) International Filing Date: 22 August 1996 (22.08.96)

(30) Priority Data:
953984 24 August 1995 (24.08.95) FI

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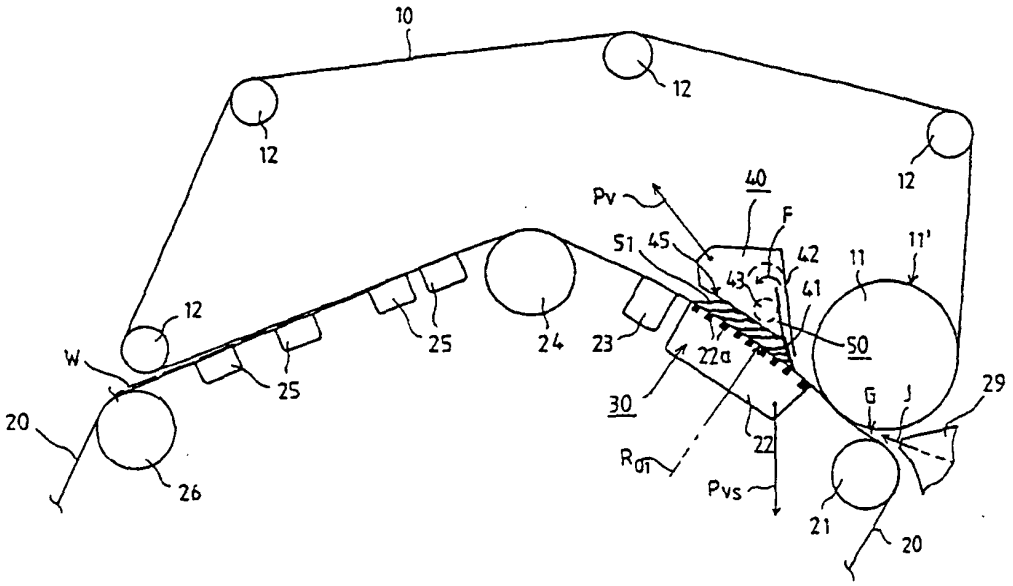
(81) Designated States: CA, JP, KR, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: WEB FORMER IN A PAPER MACHINE



(57) Abstract

The invention concerns a former section provided with a twin-wire zone in a paper machine, comprising a carrying wire (20) and a covering wire (10). These wires (10, 20) for a twin-wire zone between them, in which zone there are web-forming and draining members. In the initial part of the twin-wire zone, inside one of the wires (10, 20), there is a stationary unit (30; 40) of forming ribs, in which ther are transverse forming ribs (22a; 44) extending across the entire width of the wires (10, 20) and placed at a distance (L_2) from one anoth Placed opposite to these forming ribs (22a; 44), inside the loop of the opposite wire (10/20), there is a loading unit (50), in which therr spring blades (51) which are loaded against the wire (10/20). The dragging and loading areas (A) of these spring blades (51) are r substantially in the middle areas of the gaps between the forming ribs (22a; 44).

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Web former in a paper machine

The invention concerns a former in a paper machine, which former is provided with a twin-wire zone and which former comprises a carrying wire and a covering wire, said wires forming a twin-wire zone between them, in which zone there are web forming and dewatering members.

In web formers of paper machines, a number of different forming members are used. One of the functions of these members is to produce pressure pulsation in the fibre layer that is formed, by means of which pulsation dewatering of the web that is being formed is promoted and, at the same time, its formation is improved. Further, in the prior art, various forming shoes are known, which are usually provided with a curved ribbed deck, over which forming shoes the forming wires placed one above the other and the web placed between the wires are curved, water being drained out of the web substantially through the wire placed at the side of the outside curve by the effect of its tensioning pressure. The ribbed deck of the forming shoe produces pressure pulsation, which promotes the dewatering and improves the formation of the web.

Further, in the prior art, various forming rolls, foil ribs, suction boxes, and suction rolls are known, by whose means a difference in pressure and pressure pulsation, which promote the dewatering of the web, are produced in the fibre layer that is being formed.

Attempts are made to construct the headboxes and web formers of paper machines so that it should be possible to produce a paper whose basis weight, formation and strength properties are homogeneous across the entire width of the web and from which paper a minimal width at the edges of the web has to be cut off. From paper, in particular from fine paper, increased uniformity of the structure is required, which

is required by such recently introduced printing and copying processes in which very rapid and intensive heating of the sheet takes place.

Drawbacks involved in the use of prior-art forming members include wire damage, which arises from particles of contaminations passing between the glide faces of the forming members and the wires, which particles may produce flattening and/or shifting of the wire fibres with resulting damage to the wire. Said drawback is manifested with particular emphasis when both of the wires are placed facing two forming members, such as forming ribs, "hard against hard", the wires and the fibre web placed between them having to pass between said members.

From the prior art, various so-called MB formers are known, in which there are sets of ribs loaded against one another by means of pressure mediums. With respect to their latest embodiments, reference is made by way of example to the applicant's *FI Patent Applications Nos. 930927, 932264, 932265, 934667*, and *934999*.

The prior-art web forming members are, as a rule, complicated and of heavy construction, and cross-direction deflection occurs in them, which drawback is increased to a great extent when the paper machines become wider. Profiling of the intensity of the pressure pulsation, produced by said prior-art forming members, in the cross direction of the web is, as a rule, not possible without costly special arrangements. Also, constantly increasing running speeds of paper machines have resulted in ever increasing requirements on different web forming members.

In the applicant's *FI Patents Nos. 87,588* and *91,091* (equivalent to *US Pat. No. 5,211,814*), a wire loading device in a paper machine is described, by whose means a mechanical load is applied to the wire of the paper machine across its entire width, by means of which load a pressure pulse is applied to the fibre layer or web placed on support of a wire or between wires, by means of which pressure pulse the dewatering of the web is promoted, the formation of the web is improved, and/or the cross-direction profiles of different properties of the web are controlled, such as the cross-direction profiles of dewatering, filler distribution, formation, and/or of

retention. The loading device in accordance with said patents comprises a plate-shaped spring blade, whose side is arranged as substantially tangential to drag against the inner face of the wire loop to produce a pressure pulse. Said spring blade is attached, from outside its dragging area, to the frame part of the loading device, a loading force that curves the spring blade in the machine direction and produces said pressure pulse in the web being produced by the intermediate of said frame part and/or loading devices.

The spring blade is fitted preferably "with the fur" in relation to the run of the wire and the web, i.e. so that the blades attaching point is upstream of the blade tip with respect to the motion of the fabrics and the web, which facilitates the prevention of damage caused by fibre strings and increases the possibilities of resilience of the spring blade. A loading device provided with said spring blade is suitable for use in the web former in a number of different positions, as a rule, in a twin-wire area, but also even in the gap area of a gap former. This prior-art loading device permits versatile controls and adjustments of the transverse profiles, wherein, if necessary, closed on-line regulation systems based on measurements of the different profiles can be used.

In said *FI Patent 87,588* and in Figs. 1 and 2 of the equivalent *US Pat. 5,211,814*, the use of the spring blades concerned is described as substituted for web forming ribs loaded by means of pressure-medium hoses in a MB former. In the last-mentioned patents, the dragging areas of the spring blades are, however, fitted as facing the opposite stationary forming ribs and not between said ribs.

In the prior-art rib formers, such as MB formers, the dewatering is usually arranged as taking place in two directions, so that water is removed in a horizontal twin-wire zone also upwards against the force of gravity, which consumes a relatively large amount of dewatering energy. Moreover, in view of intensifying the dewatering, negative pressure is employed in the rib units. In the test runs carried out, the applicant has noticed that, between successive ribs, this negative pressure curves the wire that is placed at the side of lower pressure and at the side of the ribs to a

greater extent than it curves the opposite wire, whereby a bag is formed between the wires, which deteriorates the web formation and produces phenomena known as crushing in the web that is being formed. This drawback is also present in the case that, in accordance with the last-mentioned FI and US patents, loaded spring blades are used against the ribs while facing the ribs or placed in immediate vicinity of the ribs.

The object of the present invention is further development of the rib formers provided with said spring blade units so that the drawbacks discussed above are avoided.

In the prior art formers in which there are sets of MB ribs placed alternatingly one opposite to the other in a twin-wire zone, it is a further drawback that the rib loading wears the wires mechanically quite rapidly. Also, the construction of the hose-loaded MB units is quite complicated and, thus, expensive, partly also because the sets of ribs must be manufactured with high precision. By means of said sets of MB ribs, it is also quite difficult to provide a control of the cross-direction profiles of the web. The prior-art sets of MB ribs are wearing parts, which must be replaced frequently, which is quite laborious and produces quite long standstills in the production of paper.

An object of the present invention is to provide novel solutions for the problems discussed above as well as further development of rib formers that are provided with spring blade units.

In view of achieving the objectives stated above and those that will come out later, the invention is mainly characterized in that, in the initial part of the twin-wire zone, inside one of the wires, there is a stationary unit of forming ribs, in which there are transverse forming ribs which extend across the entire width of the wires and which are placed at a distance from one another, and that, placed opposite to said forming ribs, inside the loop of the opposite wire, there is a loading unit, which comprises spring blades that are loaded against the wire, the dragging and loading areas of said

spring blades being placed substantially in the middle areas of the gaps between said forming ribs.

In the present invention, when the dragging areas of the loaded spring blades are arranged in the middle areas of the gaps between the ribs, the wires can be made to stay together better in said rib gaps, and said phenomenon of crushing cannot occur. When the invention is applied, even a negative pressure effective in the gaps between the ribs is not necessarily needed, even though the use of such negative pressure is by no means excluded from the scope of the invention.

The scope of application of the present invention includes both gap formers and hybrid formers, but, based on the experiments that have been carried out so far, the most advantageous embodiments of the invention have been found in gap formers, in particular in gap formers in which said spring blade units are placed inside the upper-wire loop against a stationary rib unit placed inside the lower-wire loop, in which case the difficulties of dewatering that takes place upwards against the force of gravity are largely avoided. When spring blade units fitted in accordance with the invention are used, the wear of the wires can be reduced, and the wearing parts are mainly the spring blades, which can be arranged as relatively quickly replaceable.

In a preferred embodiment of the invention, the twin-wire zone is curved constantly in the same direction, and the dewatering is carried out primarily by the force of gravity and, if necessary, based on the kinetic energy of the water that is drained, whereby a former solution is obtained that is advantageous both in view of the construction and in view of the energy economy.

In the following, the invention will be described in detail with reference to some exemplifying embodiments of the invention illustrated in the accompanying drawing, the invention being by no means strictly confined to the details of said embodiments.

Figure 1 illustrates the preferred embodiment of the invention, i.e. a gap former in which the spring blade units are placed above, opposite to the ribs of the curved forming shoe placed underneath.

Figure 2 shows a gap former in which the spring blade units and the forming ribs are placed in the reversed order, as compared with Fig. 1.

Figure 3 shows an alternative embodiment of the initial part of the twin-wire zone in a gap former of the type shown in Figs. 1 and 2.

Figure 4 is an illustration similar to Fig. 3 of a second alternative embodiment of the initial part of the twin-wire zone.

Figure 5 is a schematic side view of a first embodiment of a hybrid former in accordance with the invention.

Figure 6 is a schematic side view of a second embodiment of a hybrid former in accordance with the invention.

Figure 7 shows a gap former in accordance with the invention in which the principal direction of the twin-wire zone is vertical and running from the bottom upwards.

Figure 8 is a vertical sectional view in the machine direction of a spring blade unit applied in the invention and of its location in the gaps between forming ribs, mainly in a former in accordance with Fig. 2.

In Figs. 1 to 4, a gap former in accordance with the invention is shown, in which a pulp suspension jet J is fed out of the discharge opening of the headbox 29 into the forming gap G between the forming wires 10 and 20. The forming gap is defined between the upper-wire loop 10 on the hollow-faced 11' forming roll 11 and the straight run of the lower wire 20 after the breast roll 21. After the forming gap G, an upwards inclined twin-wire zone starts, in which there is a combination in

accordance with the invention of a spring blade unit 50 and of a forming rib unit 30. In Figs. 2, 3 and 4, at both sides of the combination 30,50, inside the lower-wire loop 20, there are suction boxes 23a and 23b, and in Fig. 1, after the combination 30,50, there is one suction flatbox 23. In Figs. 3 and 4, the first suction box 23a has a lower-wire 20 guide deck of relatively large curve radius R_1. After the suction box 23;23a the twin-wire zone is curved downwards on the forming roll 24, which is followed by two pairs of suction flatboxes 25 inside the lower-wire loop 20. In the area of the latter one of said pairs of boxes, the web W is separated from the upper wire 10, which is guided by guide rolls 12, and is transferred, while curved on the suction roll 26, on the lower wire 20 to the pick-up point and further on the pick-up fabric into the press section (not shown).

In Fig. 1, after the forming gap G, there follows a short straight run of the twin-wire zone, after which the twin-wire zone is guided by the forming shoe 22 fitted inside the lower-wire loop, which shoe 22 is provided with a ribbed deck 22a. The ribbed deck 22a of the forming shoe 22 has a relatively large curve radius R_{01}, which is, as a rule, in a range of $R_{01} \approx 3...10$ m. This curve radius R_{01} is of the same direction as the rest of the curve form in the twin-wire zone. The interior space in the forming shoe 22 may be connected to a vacuum, which is effective in the gap spaces in the ribbed deck 22a, being illustrated by the arrow p_{VS}. Above the forming shoe 22, inside the upper-wire loop 10, there is a suction-deflector unit 40, at whose front end there is a deflector rib 41. In front of the deflector rib 41, a suction-deflector duct 42 is opened, through which the water drained through the upper wire 10 is transferred in the direction of the arrow F, mainly aided by kinetic energy and by negative pressure p_V, if any, into the chamber of the unit 40 and from there further to the side of the former through the duct 43. In connection with the bottom 45 of the suction-deflector unit 40, according to the invention, a loading unit 50 is fixed, the more detailed construction and positioning of the spring blades 51 of said unit coming out from Fig. 8. It should already be stated in this connection that the dragging areas A of the spring blades 51 operate in the middle areas of the gaps between the ribs 22a of the forming shoe 22 and load the inner face of the upper wire 10 across its entire width.

Fig. 2 differs from Fig. 1 in the respect that the forming ribs 22a/44 and the spring blades 51 in the unit 50 are in the reversed order in relation to one another. In Fig. 2, inside the upper-wire loop 10, there is a suction-deflector unit 40 similar to that described above, fully stationary forming ribs 44 being fixed in connection with the bottom 45 of said unit 40, and the spring blades 51 of the loading unit 50, which are placed inside the lower-wire loop 20, operate in the middle areas between said forming ribs 44 and load the inner face of the lower wire 20. In the area of the units 40/50, the substantial direction of the twin-wire zone between the forming ribs 44 and the spring blades 51 is straight.

Fig. 3 shows such a variation of the gap former as shown in Fig. 2 in which the twin-wire zone has an upwards inclined initial portion. In Fig. 3, the suction-deflector unit 40 is placed inside the upper-wire loop, and the loading unit 50 with its spring blades 51 is placed inside the lower-wire loop 20, i.e. in the same sequence as in Fig. 2, but in Fig. 3, unlike Fig. 2, the substantial direction of the twin-wire zone between the forming ribs 44 in the unit 40 and the spring blades 51 is curved, with the curve radius R, the centre of said curve radius R being placed at the side of the lower-wire loop 20.

The initial portion of the twin-wire zone of the gap former shown in Fig. 4 is in the other respects similar to that shown in Fig. 3, with the difference that the centre of the curve radius R of the twin-wire zone between the forming ribs 44 and the spring blades 51 is at the side of the upper-wire loop 10. In Figs. 3 and 4, the curve radius R is measured preferably in the range of $R \approx 3...10$ m. After the second forming roll 24, the twin-wire zone as shown in Figs. 3 and 4 is, for example, similar to that shown in Figs. 1 and 2.

Fig. 5 shows a first exemplifying embodiment of a hybrid former in accordance with the invention. Out of the discharge opening of the headbox 29, a pulp suspension jet J is fed onto the horizontal plane portion 20a of the lower wire 20, where the web W_0 has time to reach a certain suitable couching degree by the effect of the dewatering elements before it is passed into the twin-wire zone, to the upwards inclined

twin-wire zone starting at the rolls 21a and 11, in which zone, inside the lower-wire loop 20, there is a forming shoe 22A, which has an, alternatively curved or plane, ribbed deck 22a. The suction-deflector and loading units 40 and 50 placed inside the upper-wire loop 10 are shown to be similar to those described in Fig. 1. Also in the other respects, the twin-wire zone is shown to be substantially similar to that shown in Fig. 1. In the gap former as shown in Fig. 5, the twin-wire zone may also be similar to that shown in Fig. 2, 3 or 4.

It is a feature common of all of the formers shown in Figs. 1 to 5 that the initial part of the twin-wire zone is upwards inclined, and the final part is downwards inclined, and that the substantial direction of the twin-wire zone is horizontal.

Fig. 6 shows a second exemplifying embodiment of a hybrid former in accordance with the invention. In the same way as in Fig. 5, the pulp suspension jet J is fed out of the slice of the headbox 29 onto the single-wire initial portion 20a of the forming zone, which is formed by the lower wire 20, after which initial portion 20a the lower face of the paper web W_0, which is placed against the lower wire 20, has reached a certain couching degree before it arrives in the twin-wire zone placed between the wires 10 and 20. In Fig. 6, the substantial direction of the twin-wire zone, which is placed in the portion of the upper wire 10 placed between the guide rolls 11 and 12, is straight. Inside the upper wire 10, there is a suction-deflector unit 40, which includes forming ribs 44 similar to those described above, the dragging zones at the tips of the spring blades 51 in the loading unit 50 inside the lower-wire loop 20 being effective at the free gaps between said forming ribs 44. After the twin-wire zone 10/20, the web W follows the lower wire 20, from which it is separated at the pick-up point P and is transferred by means of the pick-up fabric (not shown) to the press section of the paper machine. The hybrid former as shown in Fig. 6 is particularly well suitable for modernization of existing fourdrinier wire parts; so that the lower-wire loop 20 with its frame constructions and possibly the headbox 29 consist of the existing fourdrinier wire construction, to which, in connection with the modernization, the upper-wire unit 10,11,12 and the suction-deflector unit 40 as well

as, inside the lower-wire loop, the loading unit 50 are added. The hybrid former as shown in Fig. 5 is also suitable for modernizations of existing fourdrinier wire parts.

Fig. 7 shows a vertical version of the gap former in accordance with the invention. The run of the twin-wire forming zone is from the bottom towards the top, and its substantial direction is vertical. Out of the slice of the headbox 29, the pulp suspension jet J is fed into the forming gap G. After the forming gap G, the twin-wire zone starts, which zone is curved on the hollow-faced 11' forming roll 11 over the sector a, whose magnitude is typically a $\approx$ 5°...45°. The sector a is followed by a short vertical joint run of the wires 10,20. After this, a forming zone in accordance with the invention is provided, which comprises a loading unit 50 and a suction-deflector unit 40 and whose curve radius R has its centre at the side of the loop of the carrying wire 20. After the sets of ribs 44,51 in the units 40 and 50, which sets of ribs are placed one opposite to the other alternatingly, there follows a vertical twin-wire zone, in which there is a suction flatbox 23B placed inside the loop of the carrying wire 20. This is followed by a second forming roll 24A, preferably a suction roll, on which the twin-wire zone is curved over a considerably large angle, after which the covering wire 10 is separated from the carrying wire 20 and from the web W on the guide roll 12a, and the web W follows the carrying wire 20 up to the pick-up point P.

The loading unit 50, which comes out best from Fig. 8, comprises a thin plate-like spring blade 51, whose tip 51a is preferably slightly rounded. The spring blade 51 extends as a unified construction across the entire width of the web and the wires 10,20. In the area of the tip 51a of the spring blade 51, there may be a perforation penetrable by water. The spring blade 51 loads and drags against the inner face of the wire 10/20 by means of its wide side, and the spring blade 51 is attached, from its edge opposite to said wide side, between the fastening parts 52a and 52b in connection with the frame part 53 of the loading device 50.

It is an essential feature of the construction and material of the spring blade 51 that the blade 51 operates as a plate spring, a dragging and loading pressure against the

wire 10,20 being produced by loading the blade from one edge so that it is curved. The blade 51 is stationary, and preferably it drags "with the fur" against the inner face of the wire loop 10,20 that it loads. Thus, in the running direction of the wires 10,20, the blade 51 fastening parts 52a,52b are placed before the dragging and loading area A of the spring blade 51. The loading units 50 are attached to the frame part 30 by means of a groove-projection fitting 56 so that the loading units 50 can be replaced rapidly by new ones when their spring blades are worn.

In Fig. 8, the separation and bag-formation of the wires is also sketched, which phenomenon was described above initially as occurring in the prior art between the forming ribs 44. In the prior art, by the effect of negative pressure, the upper wire 10C ran along the path 10C indicated by the dashed line, and the lower wire ran along the straight path 20D, whereby a bag C was formed between the wires, in which the structure of the web W was broken and the formation of the web W was deteriorated by the effect of the phenomenon known as crushing.

Fig. 8 also shows a preferred location and mode of effect of the spring blades 51 in the loading device 50 in accordance with the invention. The location of the dragging area A of the tip 51a of the spring blades 51 is in the middle area of the gaps between the forming ribs 44, the length of said gaps in the machine direction being denoted with L_2. In such a case, the spring blades 51 load the wires 10,20 against each other so that the separation and bag-formation of the wires 10,20, which was described above initially, cannot take place, because the spring blades 51 force the lower wire 20 to follow the upper wire 10 tightly while curving the wire gently. The magnitude of the curving angle depends on the loading force of the spring blades 51. In the dragging area A of the spring blades 51, on the lower face of the lower wire 20, there is a thin lubricating water film, which reduces the wear of the wire 20.

The width of the forming ribs 44 in the machine direction is denoted with L_1 and the gap between them with L_2. Said dimensions are chosen preferably in the ranges of $L_1 \approx 20...70$ mm, and $L_2 \approx 20...100$ mm, and the ratio L_1/L_2 is chosen preferably in the range of $L_1/L_2 \approx 0.2...0.8$.

In the arrangement of the loading unit 50, it is advantageous that the spring blade 51 is placed "with the fur" in relation to the running direction of the wires 10,20, i.e. so that the blades attaching point is upstream of the blade tip with respect to the motion of the fabrics and the web. The water that is drained out of the web W through the wire 10;20 acts as a lubricant in the dragging area A of the spring blade 51. If necessary, the loading unit 50 may also be provided with water supply means, which lubricate the dragging area A of the blade 51, for example, during starting of the paper machine and during other disturbance in the operation.

In Fig. 8, the linear load of the loading force of the loading unit 50 has been arranged adjustable by means of a loading hose 54 by the intermediate of a rib 55, an adjustable pressure P being applied to said rib so as to determine the dragging force applied by the spring blade 51 to the wire 20. The transverse profile of the loading force can be arranged adjustable by means of various arrangements, which come out in more detail, e.g., from said *FI Patent 87,588* (equiv. to *US Pat. 5,211,814*). As came out above, the spring blade 51 of the loading unit is made of a reversibly flexible plate spring material. It is also preferable that the ratio of the length L of the spring blade 51 to the thickness S of the plate material of the blade 51 should be in a certain range. Said ratio L/S is preferably chosen in a range of L/S = 10...1000. The optimal applications are, as a rule, in the range of L/S = 300...500. The ratio L/S also depends on the material of the spring blade. As the blade material, preferably a wear-resistant spring steel is used, for example stainless steel. Also, some plastic materials and composite and/or sandwich constructions may be possible. The spring blade 51 does not necessarily have to be of equal thickness and/or of the same material and/or of the same construction over its entire length and/or across its entire width. Another advantageous feature in the construction of the spring blade 51 is its spring action, so that, by loading the blade 51 by means of the loading means, the shape of the blade plate can be deflected in the machine direction with a relatively large curve radius $R_0 \approx 200...1000$ mm, in accordance with the conditions of elasticity and with the loads, and a wide dragging area A against the wire 10,20 can be obtained. Thus, the material of the spring blade 51 must be suitable in respect of its spring properties, and permanent deformations must

not arise in it. As a rule, the spring blade 51 is dimensioned and the spring properties of its material are chosen so that the spring constant of the bending of the blade per metre of width is in the range of 1.6...0.02 kN/mm, preferably in the range of 0.1...0.03 kN/mm. In particular in composite constructions, the spring constant may be different in the machine direction as compared with the cross direction. If necessary, the area of the spring blade 51 that will load and rub against the wire 10,20 can be provided with a wear piece or with a wear-resistant coating, for example with a ceramic layer.

In the following, the patent claims will be given, and the various details of the invention may show variation within the scope of the inventive idea defined in said claims and differ from what has been stated above by way of example only.

Claims

1. A former in a paper machine, which former is provided with a twin-wire zone and which former comprises a carrying wire (20) and a covering wire (10), said wires forming (10,20) a twin-wire zone between them, in which zone there are web forming and dewatering members, **characterized** in that, in the initial part of the twin-wire zone, inside one of the wires (10,20), there is a stationary unit (30;40) of forming ribs, in which there are transverse forming ribs (22a;44) which extend across the entire width of the wires (10,20) and which are placed at a distance (L_2) from one another, and that, placed opposite to said forming ribs (22a;44), inside the loop of the opposite wire (10/20), there is a loading unit (50), which comprises spring blades (51) that are loaded against the wire (10/20), the dragging and loading areas (A) of said spring blades being placed substantially in the middle areas of the gaps between said forming ribs (22a;44).

2. A gap former as claimed in claim 1, **characterized** in that the forming gap (G) is followed by a set of forming ribs (22a;44) and by loading units (50), which operate against each other in the initial end of the twin-wire zone and which are followed, in the twin-wire zone, by a forming roll (24), in whose area the twin-wire zone is curved downwards.

3. A gap former as claimed in claim 2, **characterized** in that, in the former, there is an upper-wire loop, in whose interior, in the area of the forming gap (G), there is a first forming roll (11), and that, in the area of the forming gap (G), the lower-wire loop (20) reaches contact with the upper wire (10) and with the forming roll (11) substantially tangentially, which is followed by a relatively short upwards inclined run of the twin-wire zone to said combination of units (30,50), and that said combination (30,50) is followed by a second forming roll (24), which is placed inside the lower-wire loop (20) and on which the twin-wire zone is made to be curved downwards.

4. A gap former as claimed in any of the claims 1 to 3, **characterized** in that, after the forming gap (G), inside the lower-wire loop, there is a forming shoe (22) provided with a curved (R) ribbed deck (22a), that opposite to said ribbed deck (22a), inside the upper-wire loop (10), a loading unit (50) is fitted, which has been attached to the bottom (45) of a suction-deflector unit (40) and which comprises loaded spring blades (51) (Fig. 1).

5. A gap former as claimed in any of the claims 1 to 3, **characterized** in that the forming gap (G) is followed by a loading unit (50), which is placed inside the lower-wire loop (20) and which comprises successive spring blades (51), and by a set of forming ribs (44), which is placed operating inside the upper-wire loop (10) opposite to said loading unit (50) and above which set of ribs (44) a suction-deflector unit (40) is fitted (Fig. 2).

6. A gap former as claimed in claim 1, **characterized** in that the substantial direction of the twin-wire zone (10,20) of the gap former is vertical and runs from the bottom upwards, that after the forming gap (G) and after a possible turning sector (a), if any, of a forming roll (11), a combination of a forming-rib unit (40) and of a loading unit (50) is provided, after which a second forming roll (24A) is fitted, after which the covering wire (10) is separated from the carrying wire (20) and from the paper web (W), the paper web being passed after this on the carrying wire (20) to the pick-up point (P) (Fig. 7).

7. A hybrid former modification of a former as claimed in any of the claims 1 to 5, **characterized** in that the inlet gap of the twin-wire zone, which corresponds to the forming gap (G) mentioned above, is preceded by a substantially horizontal single-wire run (20a) of the lower-wire loop (20), on which a preliminary stage of web formation and dewatering is carried out (Fig. 3).

8. A hybrid former as claimed in claim 7, **characterized** in that the initial part of the twin-wire zone is upwards inclined and includes a set of forming ribs (22a) placed inside the lower-wire loop (20) and a suction-deflector unit (40) placed inside

the upper-wire loop (10), a loading unit (50) that comprises a series of spring blades (51) being placed in connection with the bottom or equivalent of said suction-deflector unit (40), and after said unit (50), there is a forming roll (24), which is placed inside the lower-wire loop (20) and which curves the twin-wire zone downwards (Fig. 5).

9. A hybrid former as claimed in claim 7, **characterized** in that the substantial direction of the twin-wire zone between the lower wire (20) and the upper wire (10) is straight, and that in said twin-wire zone there is a combination of a forming-rib unit (40) and of a loading unit (50) that comprises spring blades (51) (Fig. 6).

10. A former as claimed in any of the claims 1 to 9, **characterized** in that the loading unit (50) comprises a plate-like spring blade (51), whose side is arranged substantially tangentially to the principal direction of the run of the wires (10;20) to drag against the inner face of the wire (10;20) loop to produce a loading pressure, and that said spring blade (51) is attached, from outside its dragging area, to the frame part (53) of the loading device, a loading force that curves the spring blade (51) in the machine direction and that produces said loading pressure being produced by means of said frame part (53) and/or by means of loading means (54,55).

11. A former as claimed in claim 10, **characterized** in that the ratio of the length L of the spring blade (51) in the machine direction to the thickness S of the flexible plate material of the spring blade (51) has been chosen in the range of L/S = 10...1000, preferably in the range of L/S = 300...500.

12. A former as claimed in claim 10 or 11, **characterized** in that the spring blades (51) are arranged to operate "with the fur", i.e. so that the blades attaching point is upstream of the blade tip, with respect to the running direction of the wires (10,20) against which the spring blade (51) drags, so that the spring blade (51) is attached from the inlet side of the wires (10,20).

13. A former as claimed in any of the claims 10 to 12, **characterized** in that the distribution of the linear load in the dragging area of the spring blade (51) in the cross direction has been arranged adjustable and controllable by means of devices by whose means an adjustable power field is applied to the spring-blade side opposite to the dragging side of the spring blade (51).

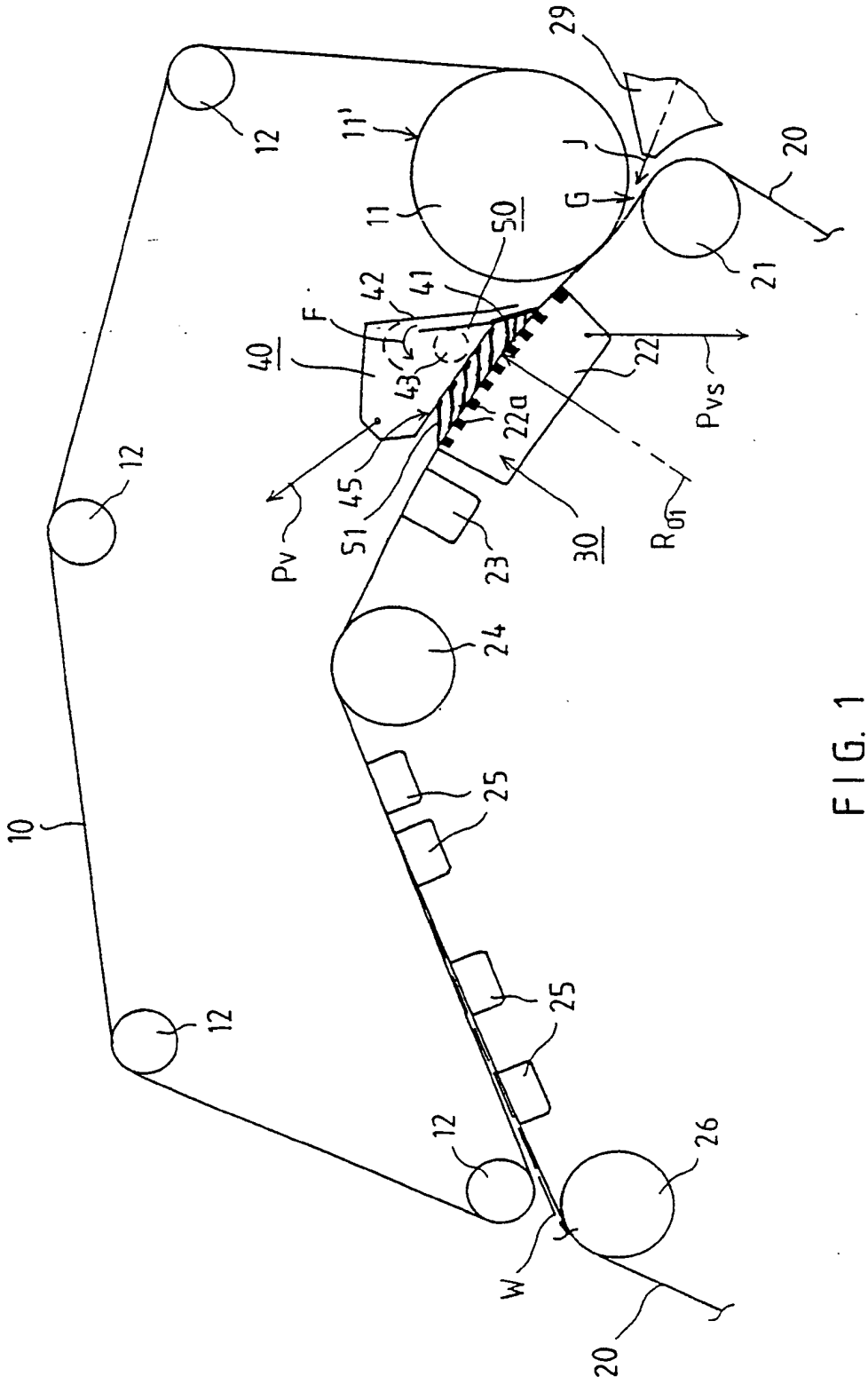

29
12
11'
J
20
G
11
50
42
41
F
40
43
22
Pvs
22a
12
45
51
Pv
23
30
R_{01}
24
25
10
25
12
12
26
W
20

FIG. 1

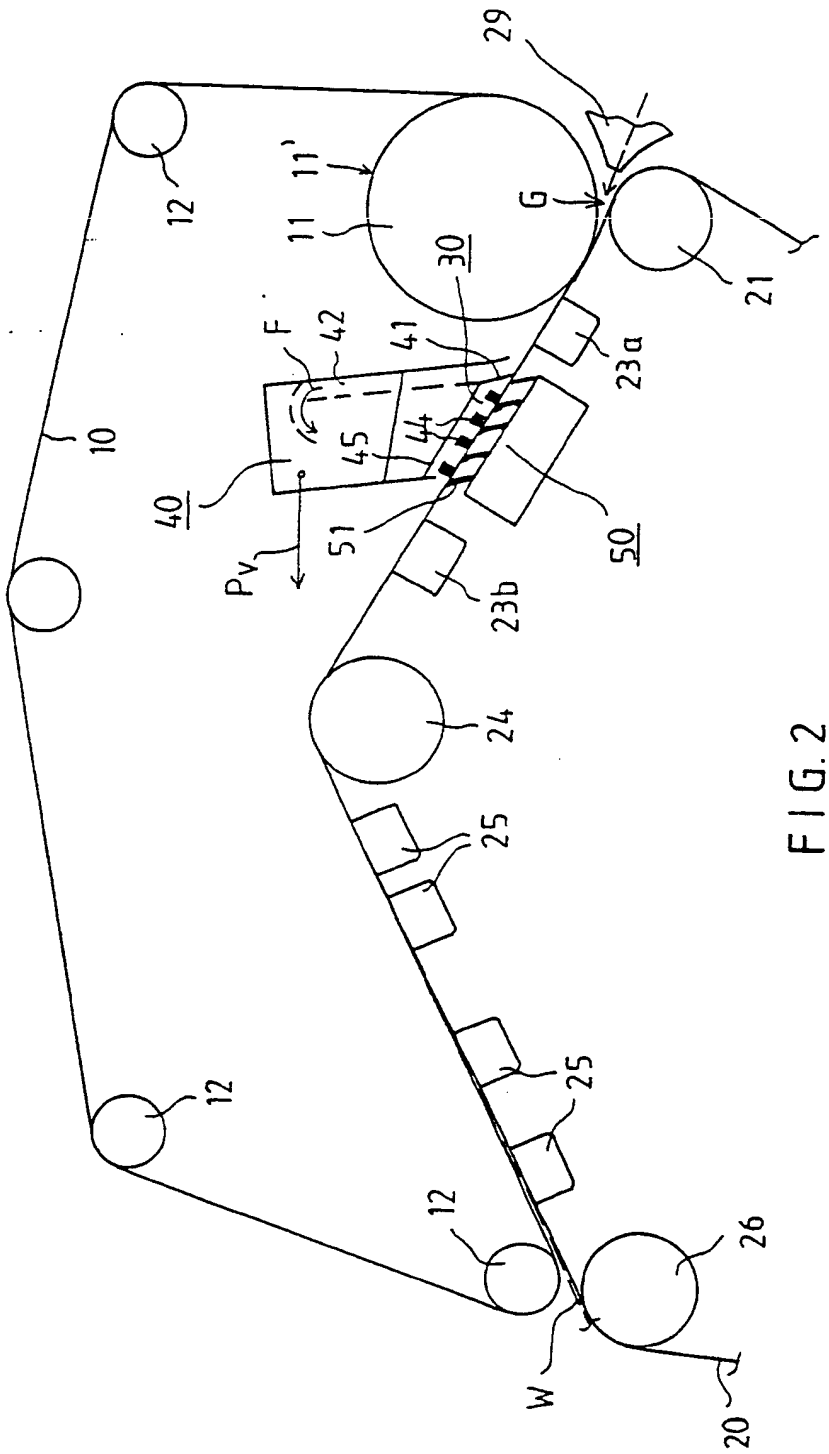

29
12
11
11'
G
30
21
F
42
41
23a
10
45
44
40
51
50
Pv
23b
24
25
25
12
12
26
W
20

FIG. 2

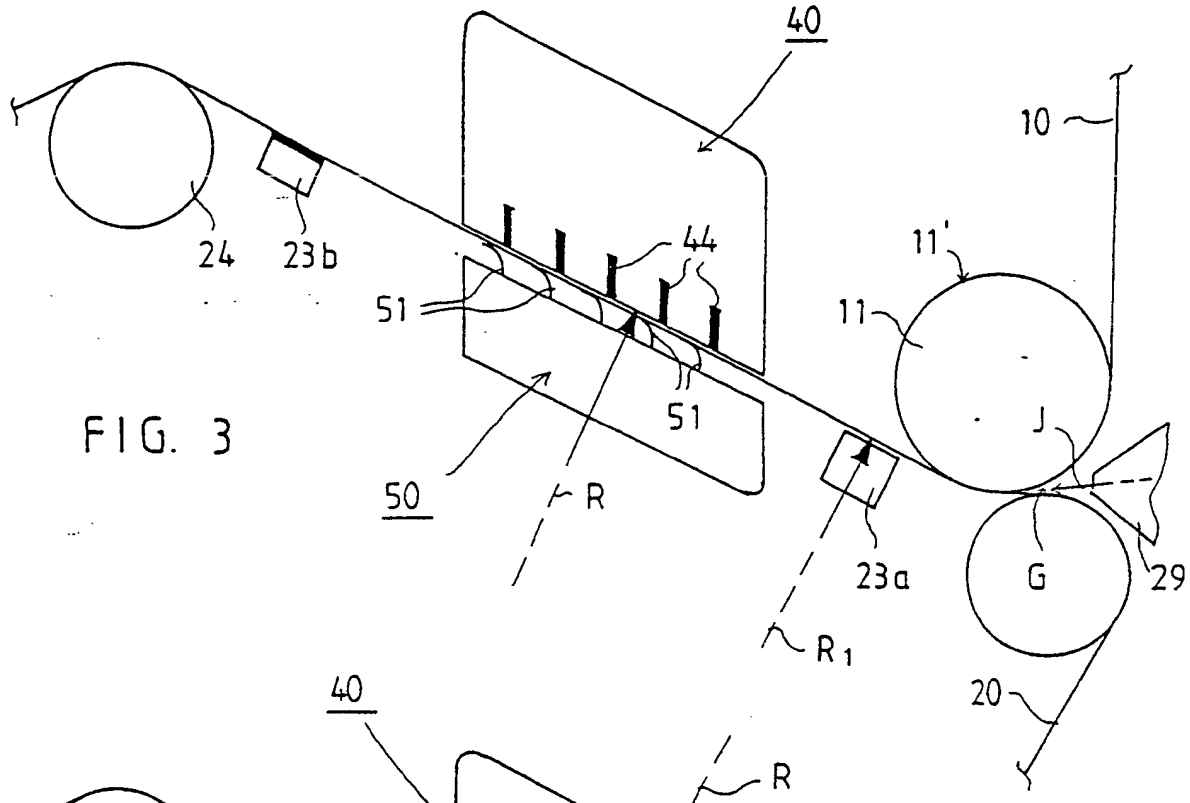

40
10
24
23b
44
11'
51
11
51
J
50
R
23a
G
29
R1
20

FIG. 3

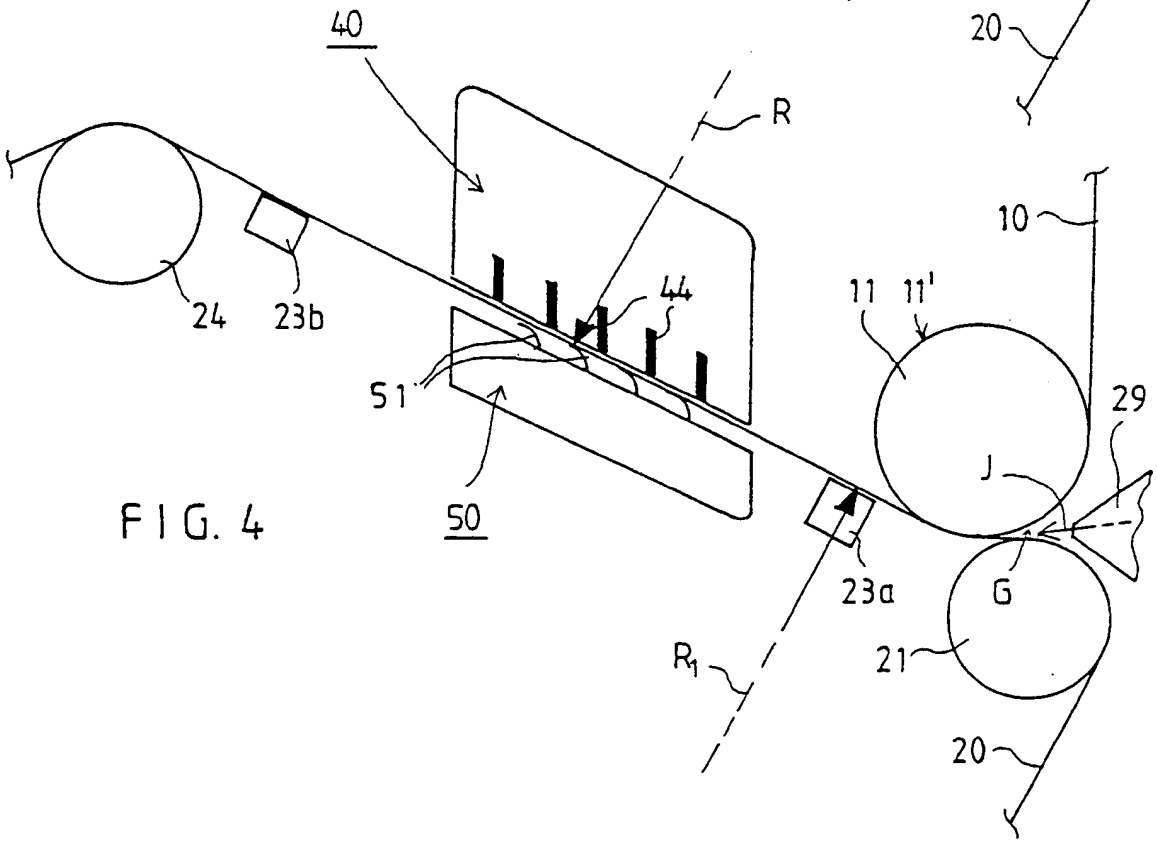

40
R
10
24
23b
44
11
11'
51'
29
J
50
23a
G
R1
21
20

FIG. 4

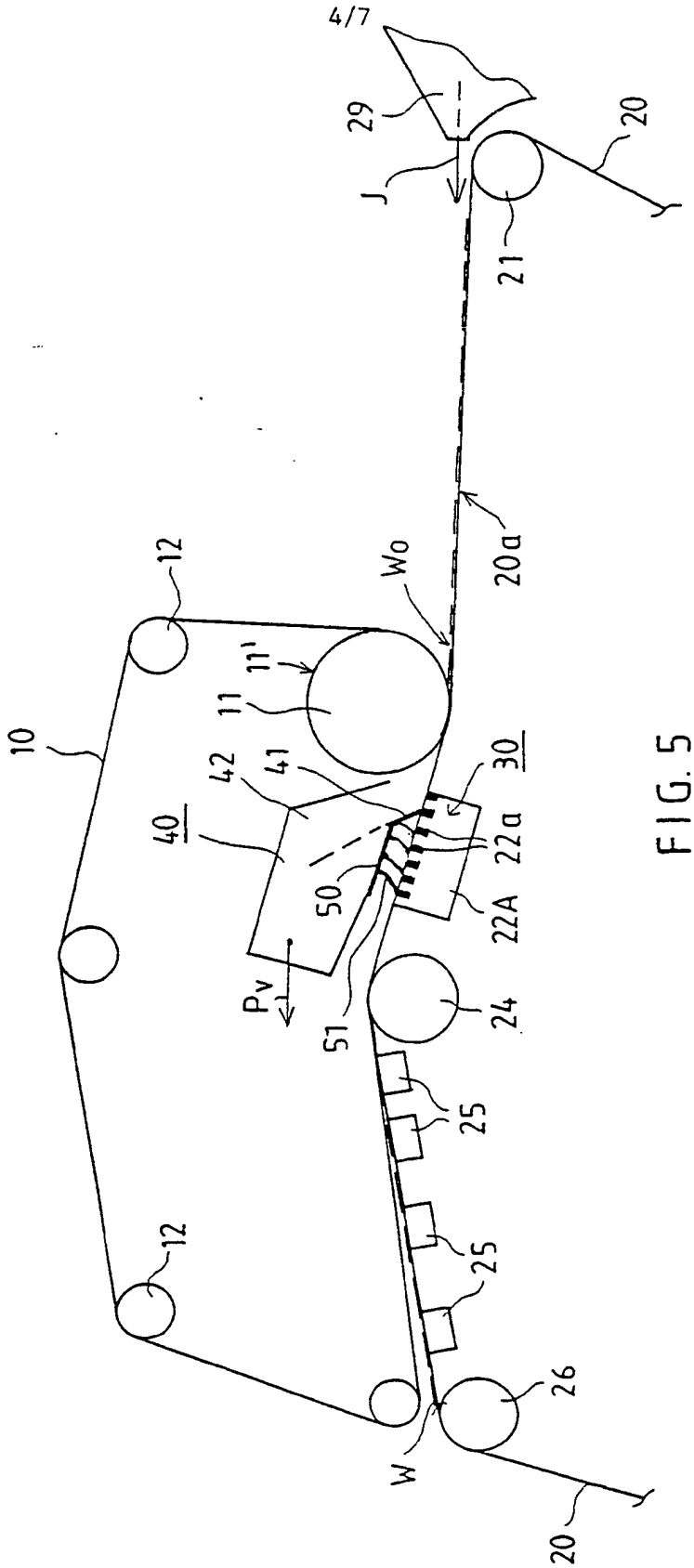
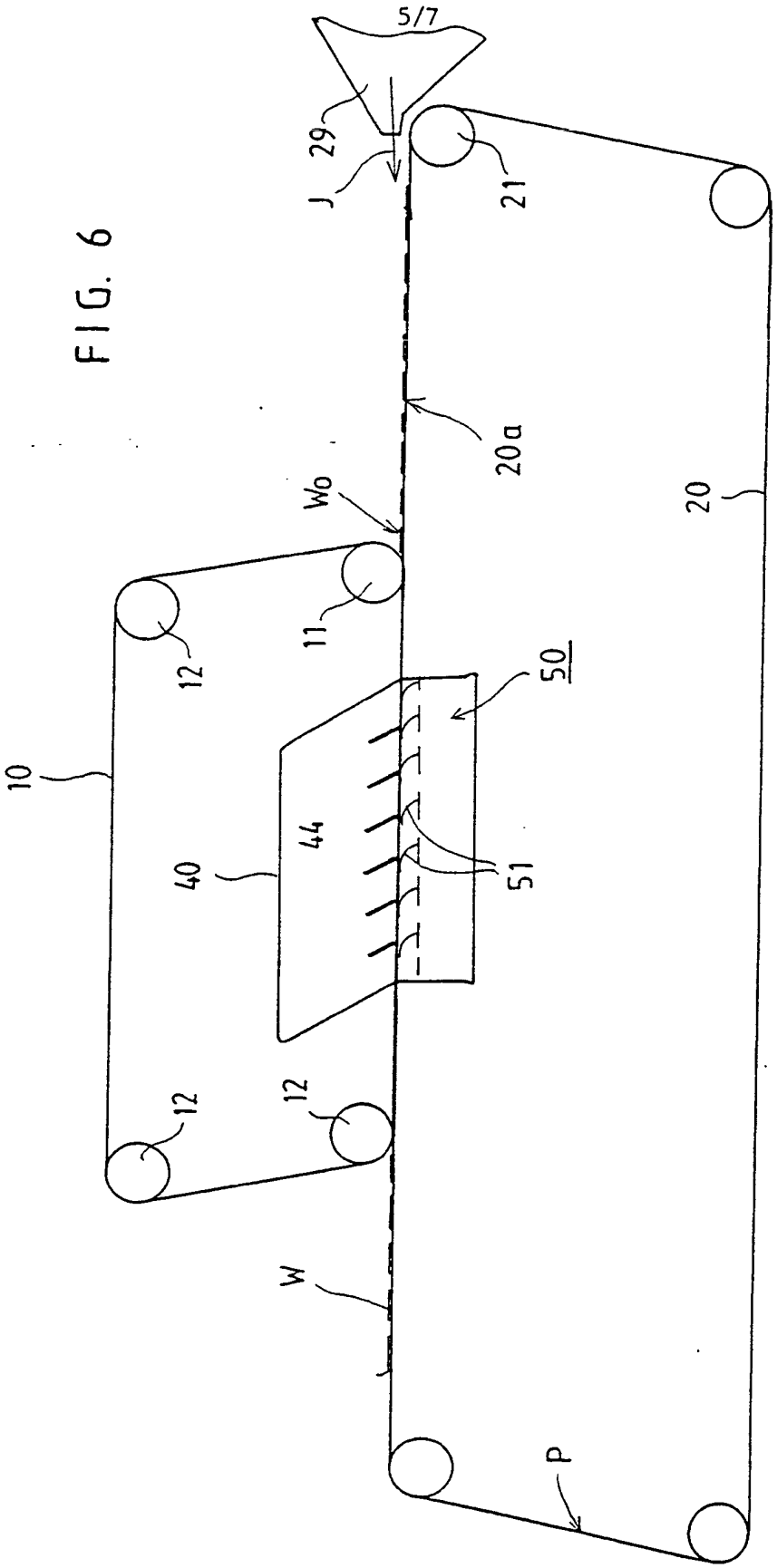

29
J
20
21
20a
Wo
12
11'
11
10
42
41
30
40
22a
22A
50
Pv
51
24
25
25
12
26
W
20

FIG. 5

FIG. 6



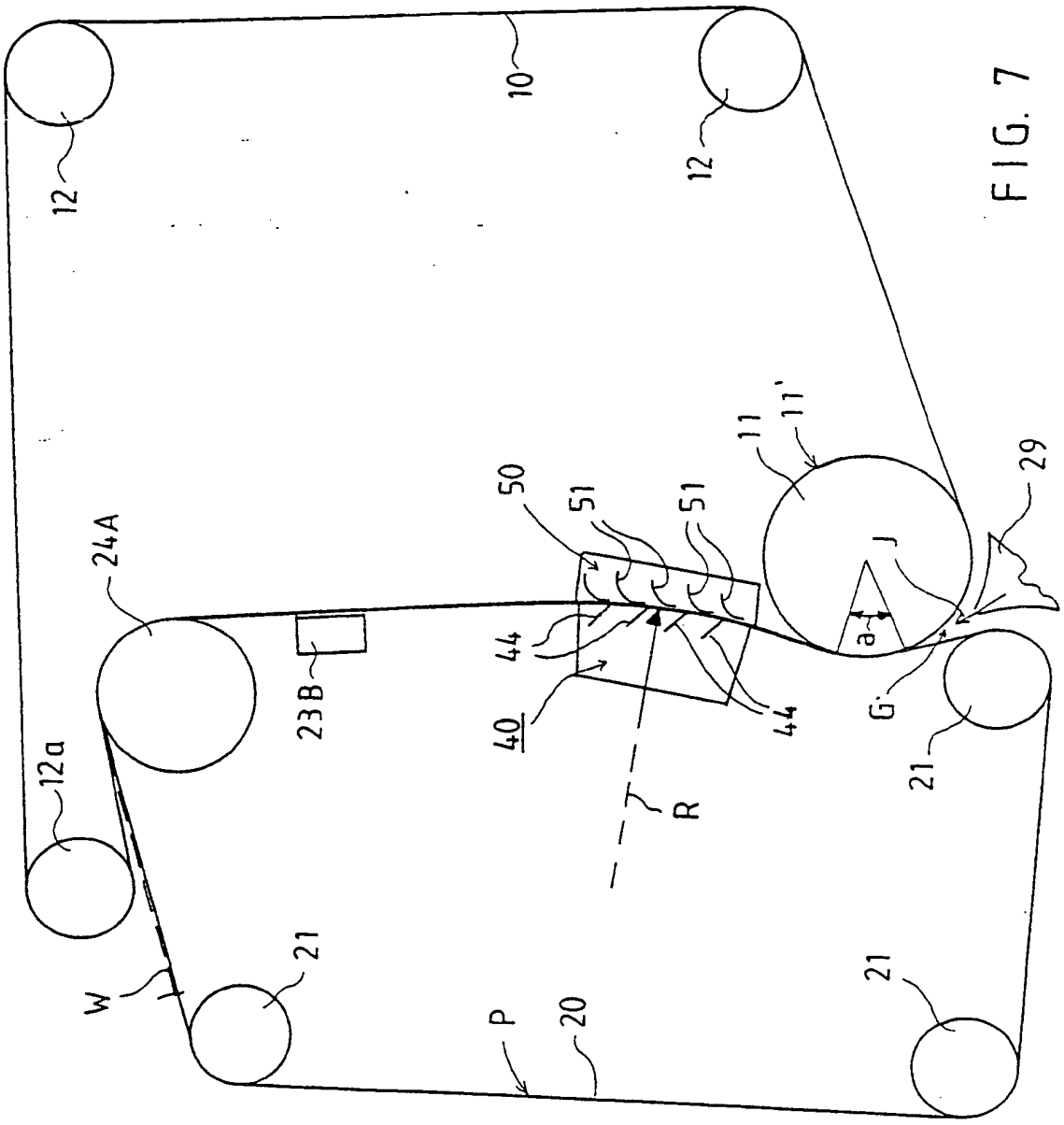


FIG. 7

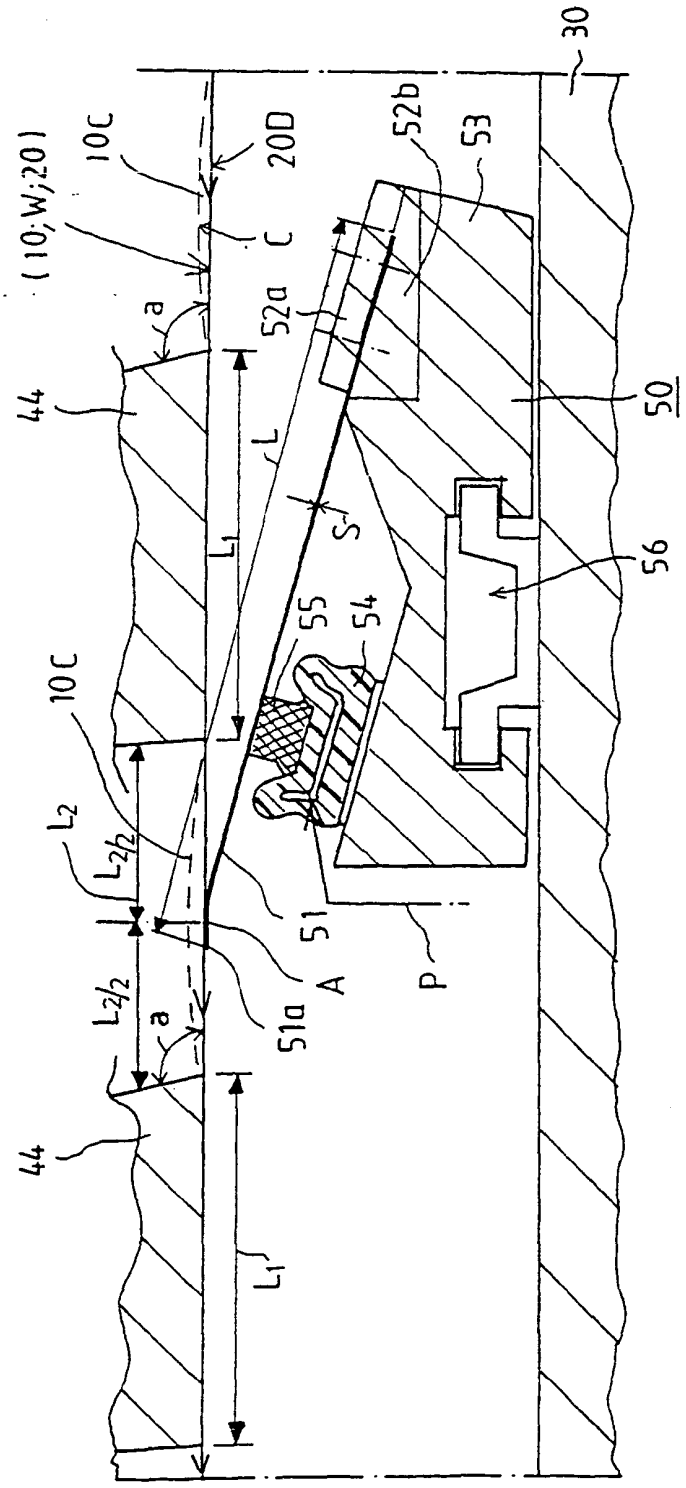

30
10C
20D
52b
53
(10;W;201)
C
a
52a
44
50
L
L1
S
56
55
54
10C
L2
L2/2
51
A
P
51a
L2/2
a
44
L1

FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 96/00451

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: D21F 1/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: D21F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5211814 A (JYRKI JAAKKOLA ET AL), 18 May 1993 (18.05.93) --	1
A	EP 0629740 A1 (VALMET PAPER MACHINERY INC.), 21 December 1994 (21.12.94) --	1

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 November 1996	28 -11- 1996
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Olov Jensén Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

Information on patent family members

28/10/96

International application No.
PCT/FI 96/00451

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 5211814	18/05/93	CA-A,C- 2067986	01/12/92
		EP-A- 0516601	02/12/92
		JP-A- 5214693	24/08/93
		FI-C- 91091	10/05/94
EP-A1- 0629740	21/12/94	CA-A- 2126115	18/12/94
		FI-B,C- 92940	14/10/94
		FI-D- 932793	00/00/00
		FI-A- 942027	18/12/94
		US-A- 5552021	03/09/96